



Mansoura University
Faculty of Computers and Information
Department of Information Technology



[IT323] Soft Computing

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COURSE SYLLABUS

- Part 1: Introduction to soft computing
- Part 2: Fuzzy logic
- Part 3: Artificial Neural Network (ANN)
- Part 4: Genetic algorithms
- Part 5: Hybrid Systems

CLASSROOM RULES

- *Be on-time.*
- The medical *mask* is mandatory to attend the class.
- Enter the classroom in an *orderly way* and go straight to your seat and set according to the *sticks* on the seat.
- Put your *mobile phone* on silent mode during the class.
- No *speaking* without permission. Raise your *hand* if you have a question.
- No *liquids or food* in the classroom.
- *Respect* the teacher, classroom, and other students.

GRADING

- *Quizzes:* 10
- *Midterm exam:* 10
- *Practical grades:* 10
- *Oral exam:* 10
- *Final:* 60



Part 1

Introduction to soft computing

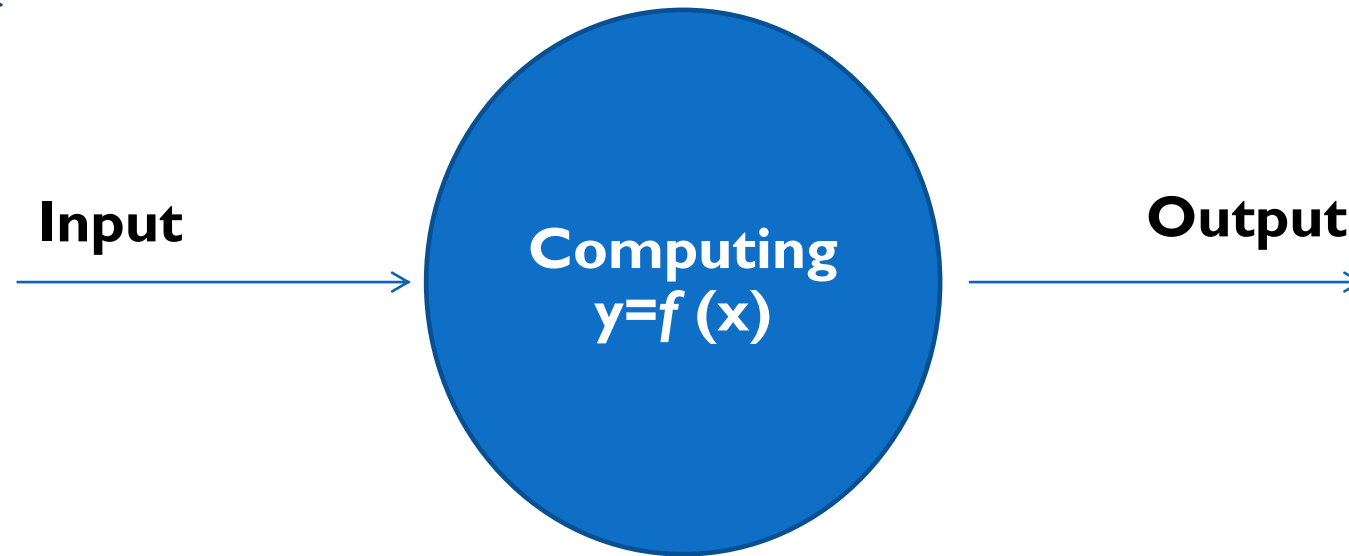
OUTLINE

- What is Computing?
- Hard Computing
- Soft Computing
- Hard Computing vs. Soft Computing

WHAT IS COMPUTING?

- Computing is a **mapping** function from set of input to output.
- Also called **formal method** or **algorithm**.

Algorithm to solve a problem.



HARD COMPUTING

- Introduced by Dr. Lotfi Aliasker Zade (1996) who defined a computing to be **hard computing** if it:
 1. Generate **precise results**.
 2. Utilized control actions are **unambiguous**.
 3. The control actions are **formally defined** (i.e., algorithm, or mathematical model).

HARD COMPUTING (CONT.)

- Examples of Hard computing:
 1. Solving numerical problems (e.g., integration, derivation, etc.).
 2. Searching and sorting techniques.
 3. Solving computational geometry problems (e.g., finding closest pair of points given a set of points).

SOFT COMPUTING

- **Def1:** A collection of methodologies that aim to exploit the tolerance for imprecision and uncertainty to achieve flexibility, robustness, and low solution cost.

مجموعة من المنهجيات التي تهدف إلى استغلال التسامح مع عدم الدقة وعدم اليقين لتحقيق المرونة والمتانة وتكلفة الحل المنخفضة

----- Dr. Lotfi Aliasker Zade

Robustness, means it can tackle any sort of input noise المتانة ، تعني أنه يمكنه معالجة أي نوع من ضوضاء الإدخال

It is computationally very cheap (low solution cost). → real time applications.

- **Def2:** Automating the process of computing when the program learns by its own.

The main goal of Soft Computing is to develop intelligent machines to provide solutions to real world problems, which are not modeled, or too difficult to model mathematically.

SOFT COMPUTING (CONT.)

- Soft computing characteristics:
 1. The results **not necessarily to be precise**, they are **uncertain**.
 2. Does not require any **mathematical model** of problem solving.
 3. The followed **control steps** are **not necessarily be certain** or **unambiguous**.
 4. The algorithms are **adaptive**; (i.e., can **adjust to the change** of any dynamical situation).

SOFT COMPUTING (CONT.)

- Why soft computing?
- **Mathematical model** & analysis can be done for relatively **simple systems**.
- More **complex systems** arising in biology, medicine & management systems remain intractable to conventional mathematical & analytical methods.
- Act like human in: taking decisions, derive inference from previous situations experienced, expertise in an area, adapt to changing environment, learn to do better, and social behavior of collective intelligence.

SOFT COMPUTING (CONT.)

- There are three computing paradigms:
 1. fuzzy logic: taking decisions, and derive inference from previous situations experienced.
 2. neural computing: expertise in an area, and adapt to changing environment.
 3. probabilistic reasoning: learn to do better, and social behavior of collective intelligence.

The role model for soft computing is in fact human mind

SOFT COMPUTING (CONT.)

- In general, these methods:
 1. Have ability to deal with **non linearity**.
 2. Follow more **human like** reasoning paths than classical methods.
 3. Utilize **self learning**.
 4. Utilize **yet-to-be proven** theorems. استخدم النظريات التي لم يتم إثباتها بعد.
 5. Are **robust** in the presence of noise or errors.

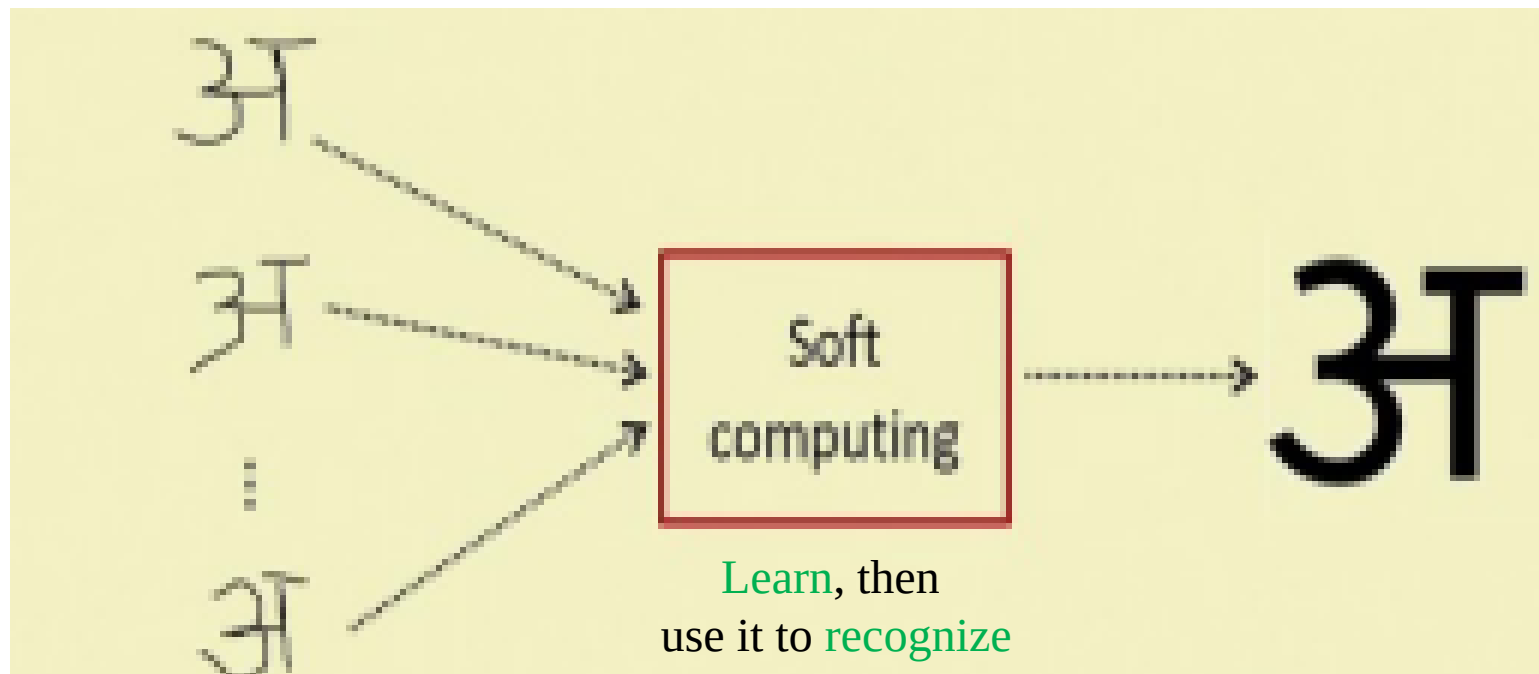
SOFT COMPUTING (CONT.)

The role model for soft computing is in fact human mind

- Example: Artificial Neural Network (ANN):
- How a student learns from his teacher?
 - ✓ Teacher ask questions and give the answers.
 - ✓ Then, teacher puts some questions and hints the answers and ask.
 - ✓ Then, students thus learn a topic and store it in their memory.
 - ✓ Finally, based on the knowledge he can then solve many new problems assigned to him.

SOFT COMPUTING (CONT.)

- Example of ANN:



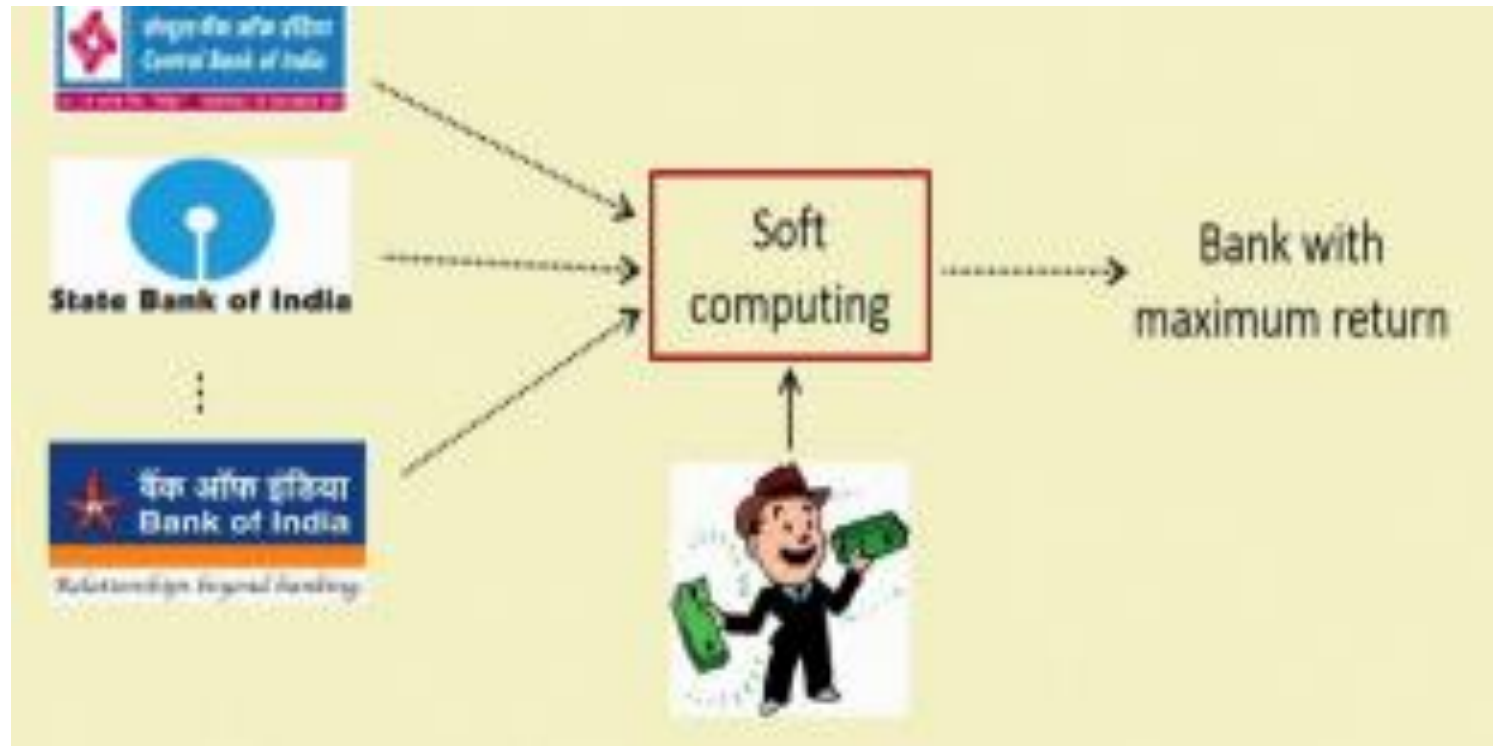
SOFT COMPUTING (CONT.)

The role model for soft computing is in fact human mind

- Example: Genetic Algorithm (GA):
- *Note: GA is an example of evolutionary computing/probabilistic reasoning*
- How to obtain an optimal solution?
 - ✓ Start with some random solutions those are not necessary to be an optimal.
 - ✓ Rank the solution and select the superior individuals.
 - ✓ Reproduce from this set of solution (next generation) another solution until selecting the best solution.

SOFT COMPUTING (CONT.)

- Example of evolutionary computing/ probabilistic reasoning:



SOFT COMPUTING (CONT.)

The role model for soft computing is in fact human mind

- Example: Fuzzy Logic (FL):
- How the doctor treats his patient?
 - ✓ Doctor asks the patient about the problem.
 - ✓ He finds the symptoms of disease from the patients input.
 - ✓ Then doctor prescribe some tests and medicine. (Predict).
- Notes:
 - The *symptoms* are correlated with disease uncertainty.
 - The doctor prescribe medicines or whatever the test it is also *fuzzily*.

SOFT COMPUTING VS. HARD COMPUTING

Hard Computing	Soft Computing
Conventional computing requires a precisely stated analytical model.	Soft computing is tolerant of imprecision.
Often requires a lot of computation time.	Can solve some real world problems in reasonably less time.
Not suited for real world problems for which ideal model is not present.	Suitable for real world problems.
It requires full truth	Can work with partial truth
It is precise and accurate	Imprecise.
High cost for solution	Low cost for solution
Require programs to be written	Can evolve its own programs
Deterministic	Stochastic
Require exact input	Can deal with ambiguous and noisy data
Produce precise answer	Produce approximate answers

الاحتمالية

العشوائية

REFERENCES

- Prof. Debasis Samanta. “Introduction to Soft Computing” Indian Institute of Technology, Kharagpur https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/106105173/lec1.pdf.
- <https://www.youtube.com/watch?v=mlfM4SGOAg0> [last access March 3rd, 2020].
- Pradeep Sharma, Abhishek Raghuvanshi, Ruchika Pachori. “Artificial intelligence and Soft computing: Soft Computing Techniques: Artificial Intelligence, Neural Networks, Fuzzy Logic and Genetic Algorithm.” Educreation Publishing, 2019.